

US007421646B1

(12) **United States Patent**
Leung

(10) **Patent No.:** **US 7,421,646 B1**
(45) **Date of Patent:** **Sep. 2, 2008**

(54) **SYSTEM AND METHOD FOR SCHEMALESS DATA MAPPING**

(75) Inventor: **Yiu-Ming Leung**, Kirkland, WA (US)

(73) Assignee: **Microsoft Corporation**, Redmond, WA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/649,461**

(22) Filed: **Jan. 3, 2007**

Related U.S. Application Data

(63) Continuation of application No. 10/772,001, filed on Feb. 4, 2004, now abandoned.

(51) **Int. Cl.**
G06F 17/00 (2006.01)

(52) **U.S. Cl.** **715/212**

(58) **Field of Classification Search** **715/503,**
715/212

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,631,497 B1 * 10/2003 Jamshidi et al. 715/514
6,804,677 B2 * 10/2004 Shadmon et al. 707/101
6,920,608 B1 * 7/2005 Davis 715/209

6,925,470 B1 * 8/2005 Sangudi et al. 707/102
6,941,511 B1 * 9/2005 Hind et al. 715/235
7,017,112 B2 * 3/2006 Collie et al. 715/212
2003/0188264 A1 * 10/2003 Nawathe et al. 715/513

OTHER PUBLICATIONS

Chan et al., "Efficient filtering of XML documents with XPath expressions", The VLDB Journal, vol. 11, Issue 4, Dec. 2002, p. 354-379.*

Torsten et al., "Accelerating XPath location steps", Proceedings of the 2002 ACM SIGMOD international conference on Management of data, 2002, p. 109-120.*

* cited by examiner

Primary Examiner—Doug Hutton

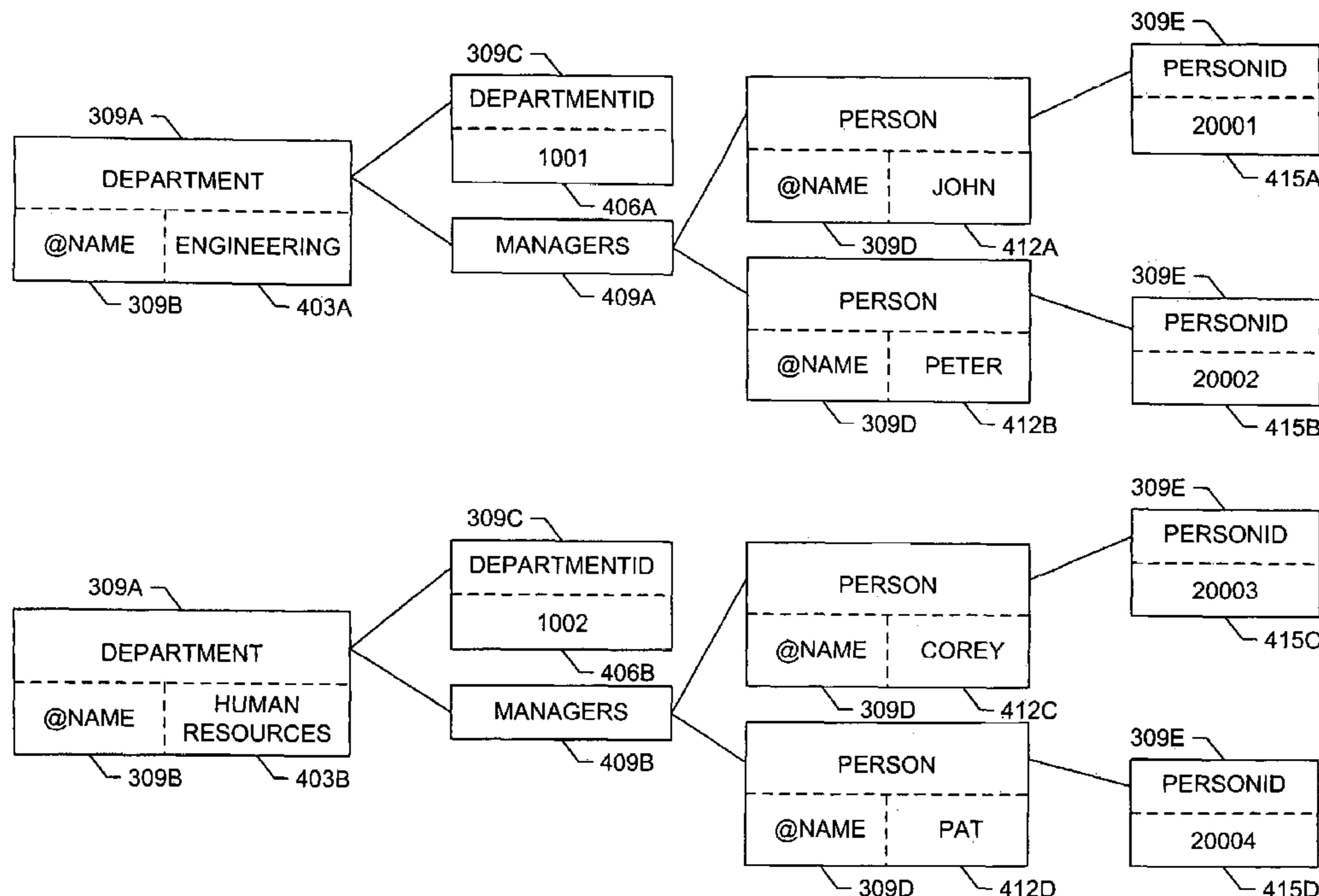
Assistant Examiner—Amelia Rutledge

(74) *Attorney, Agent, or Firm*—Merchant & Gould

(57) **ABSTRACT**

A system and method for mapping payload data to a spreadsheet list. The present invention comprises a system for mapping payload data to a spreadsheet list without the use of a schema. After receiving a spreadsheet list, the present invention generates the parent path of each field path defined in the spreadsheet list. The longest parent path may be used to generate a set of bind nodes from the payload data. The present invention may map each bind node to a row in the spreadsheet list. By traversing from each bind node using the bottom path and the field paths, the present invention may obtain the values of all of the other fields in the rows of the spreadsheet list.

10 Claims, 9 Drawing Sheets



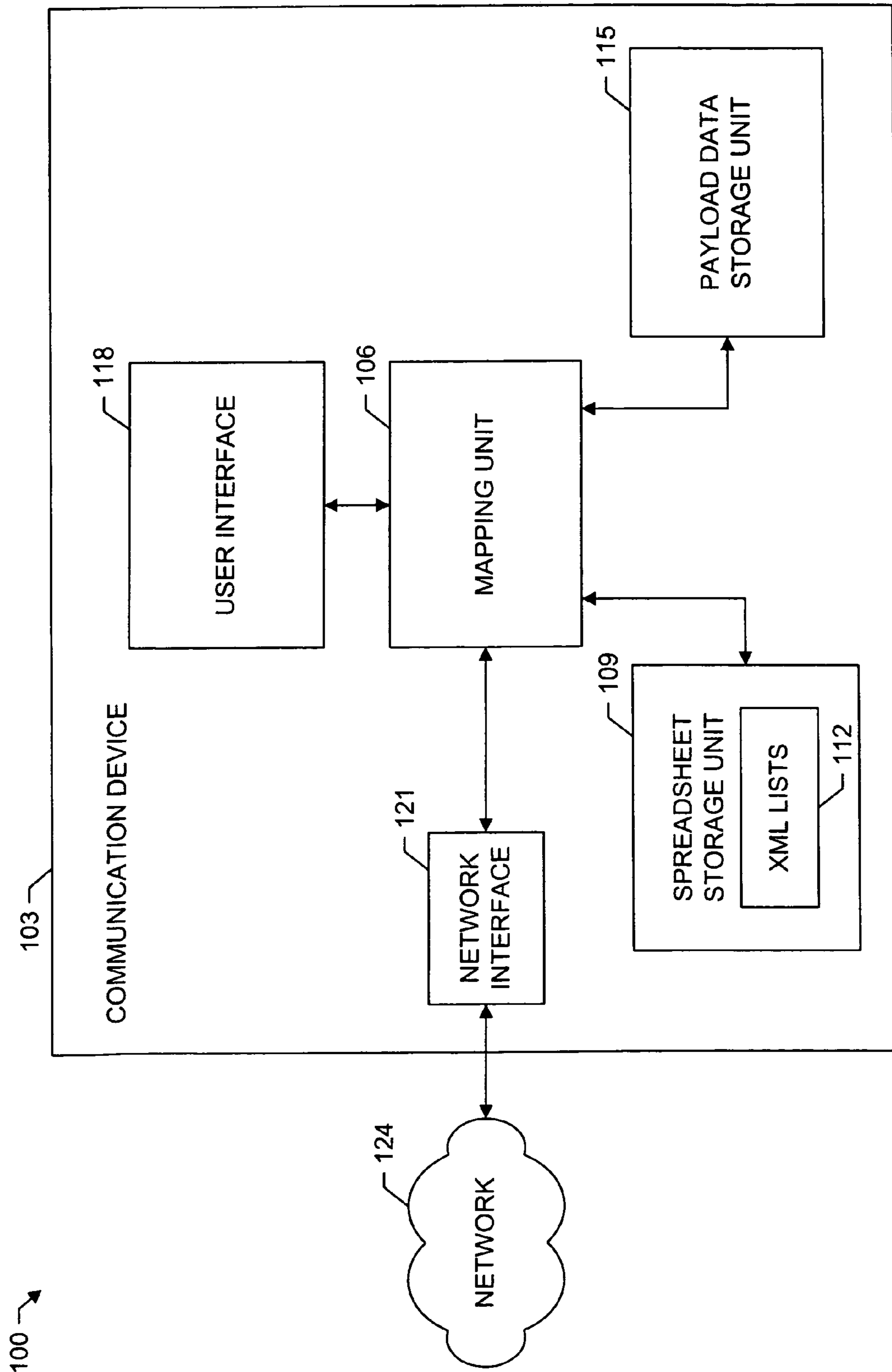


FIG. 1

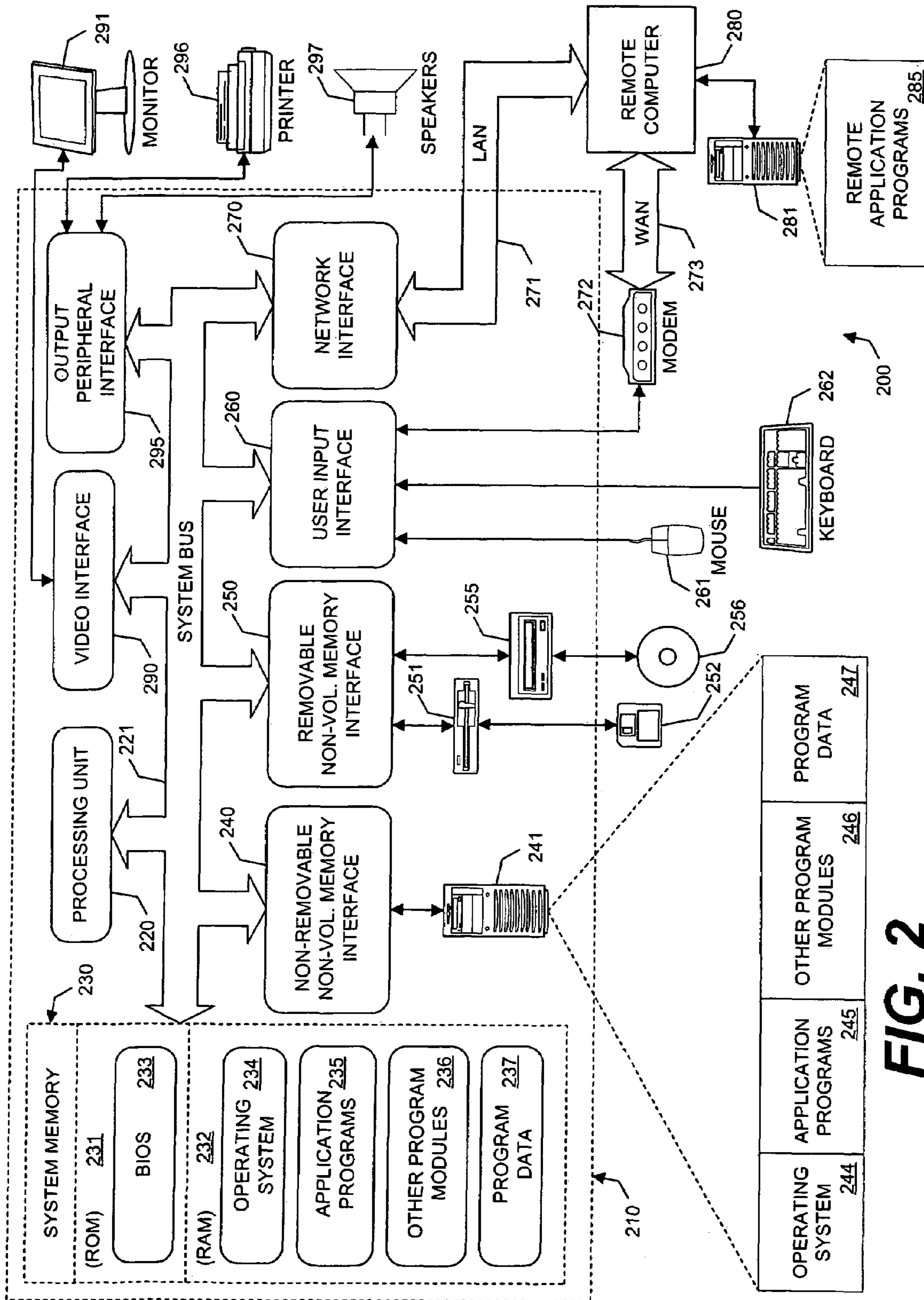


FIG. 2

300 ↘

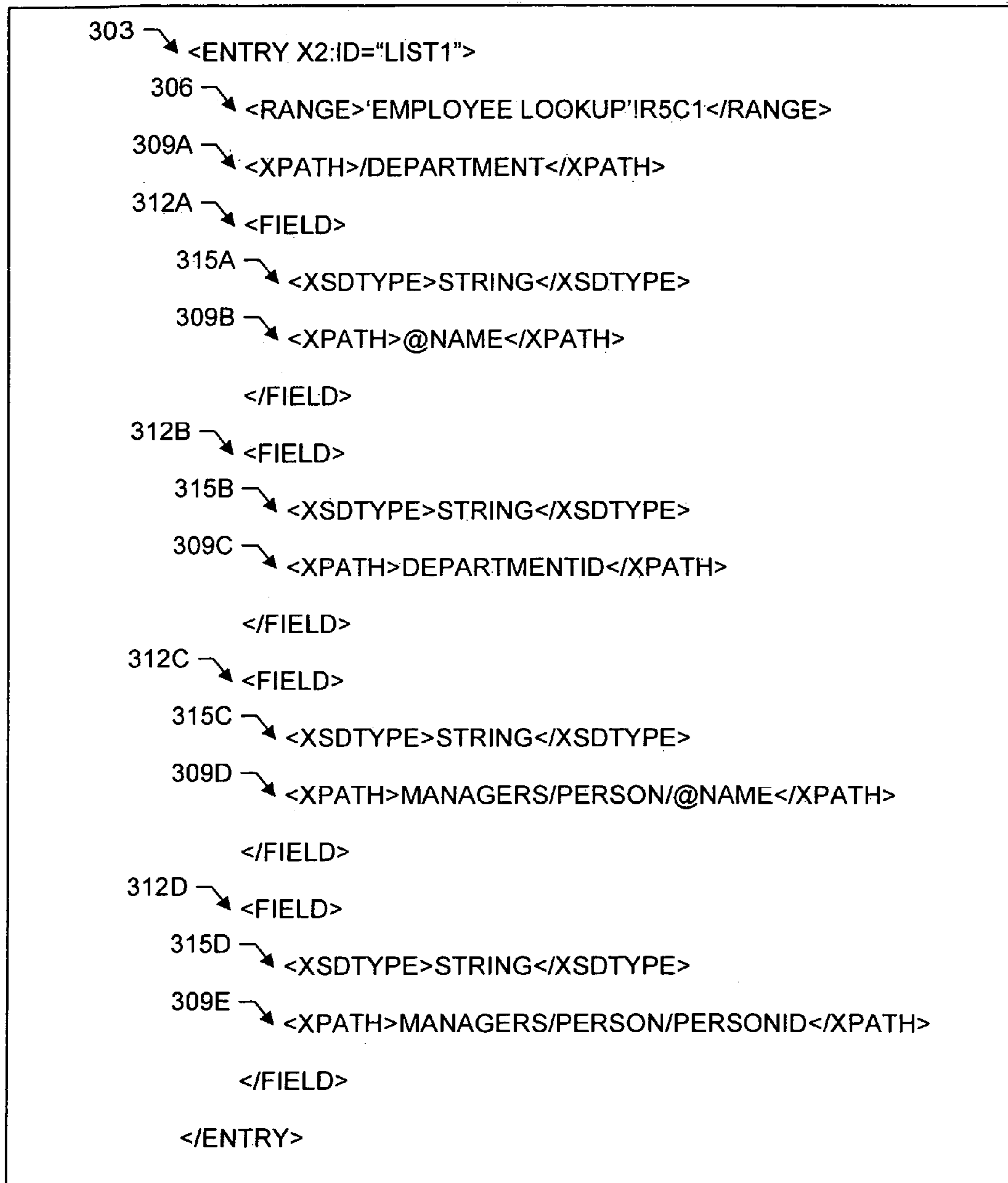


FIG. 3

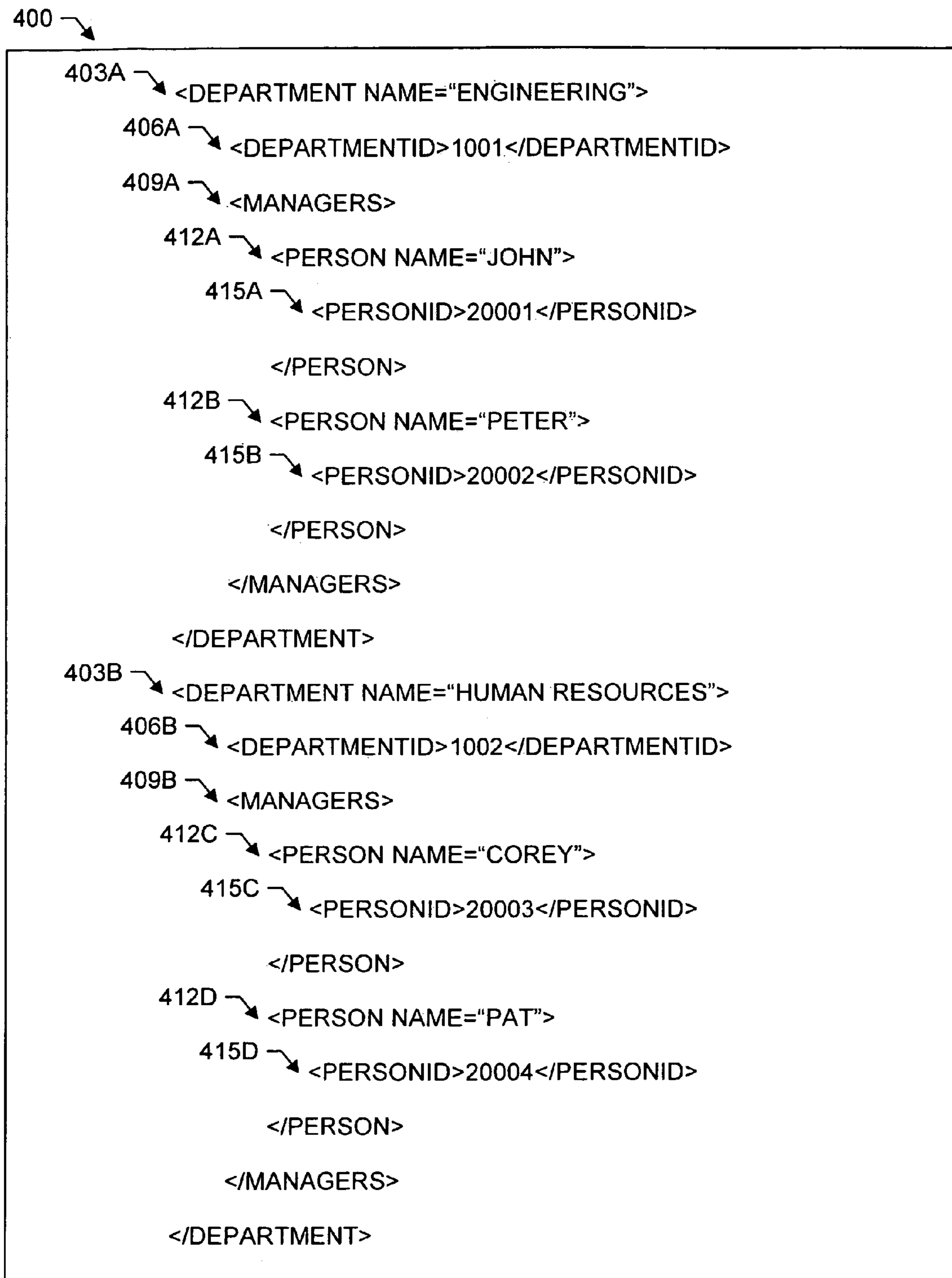


FIG. 4

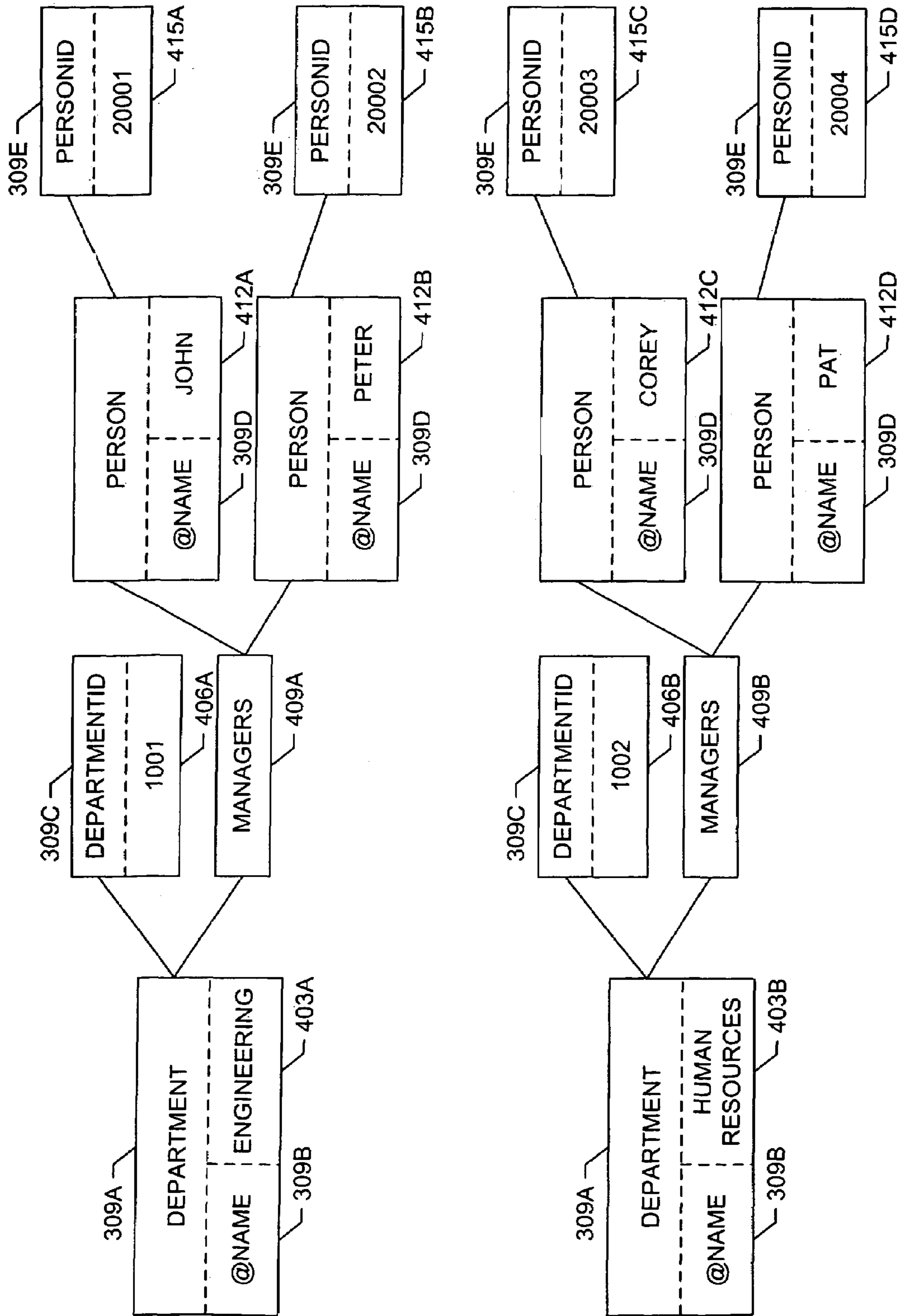


FIG. 5

600 →

	603	606	612	615
	A	B	C	D
618	1	NAME	PERSONID	
621	2	ENGINEERING	1001	JOHN
624	3	ENGINEERING	1001	PETER
627	4	HUMAN RESOURCES	1002	COREY
630	5	HUMAN RESOURCES	1002	PAT

FIG. 6

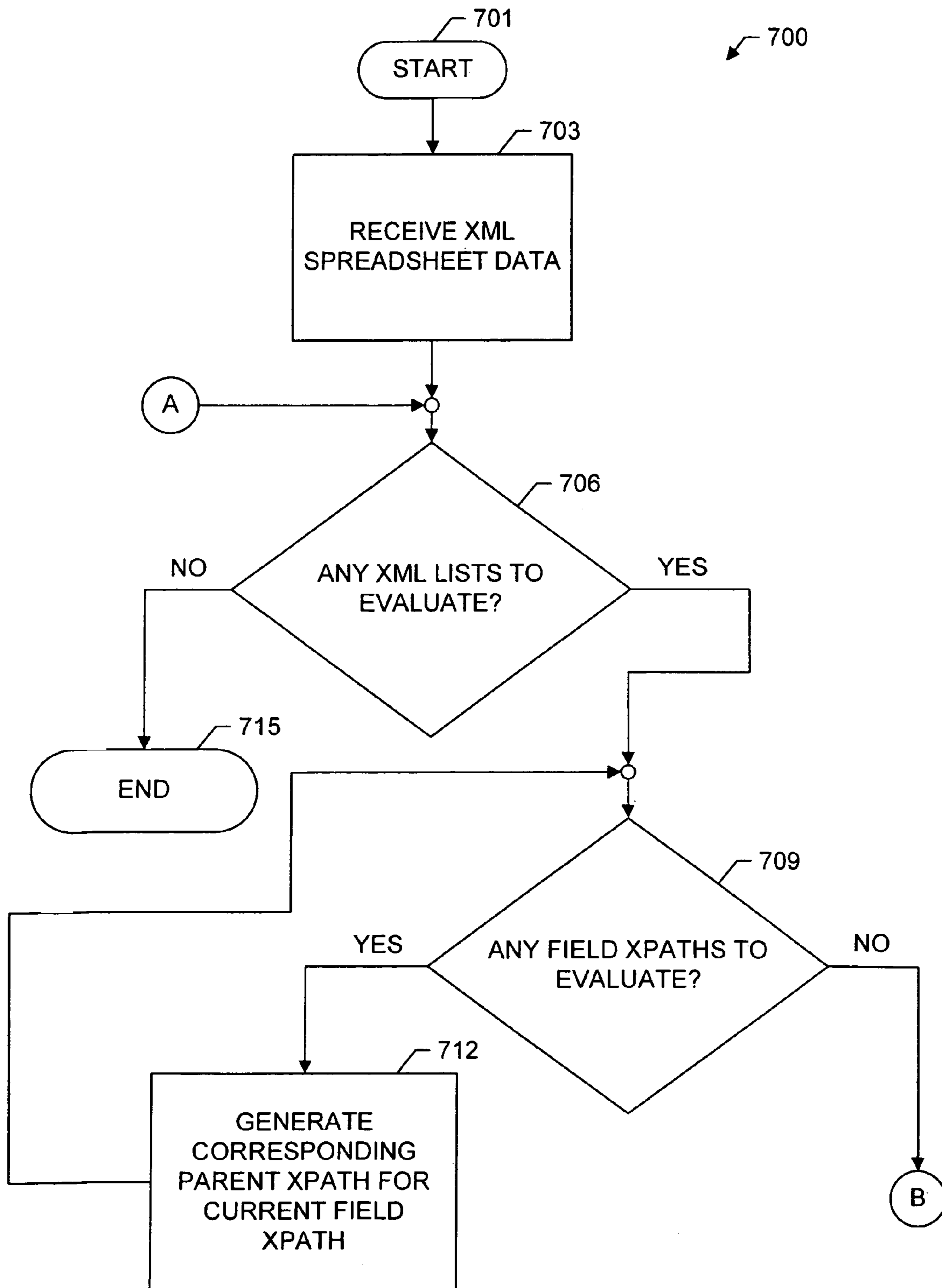


FIG. 7A

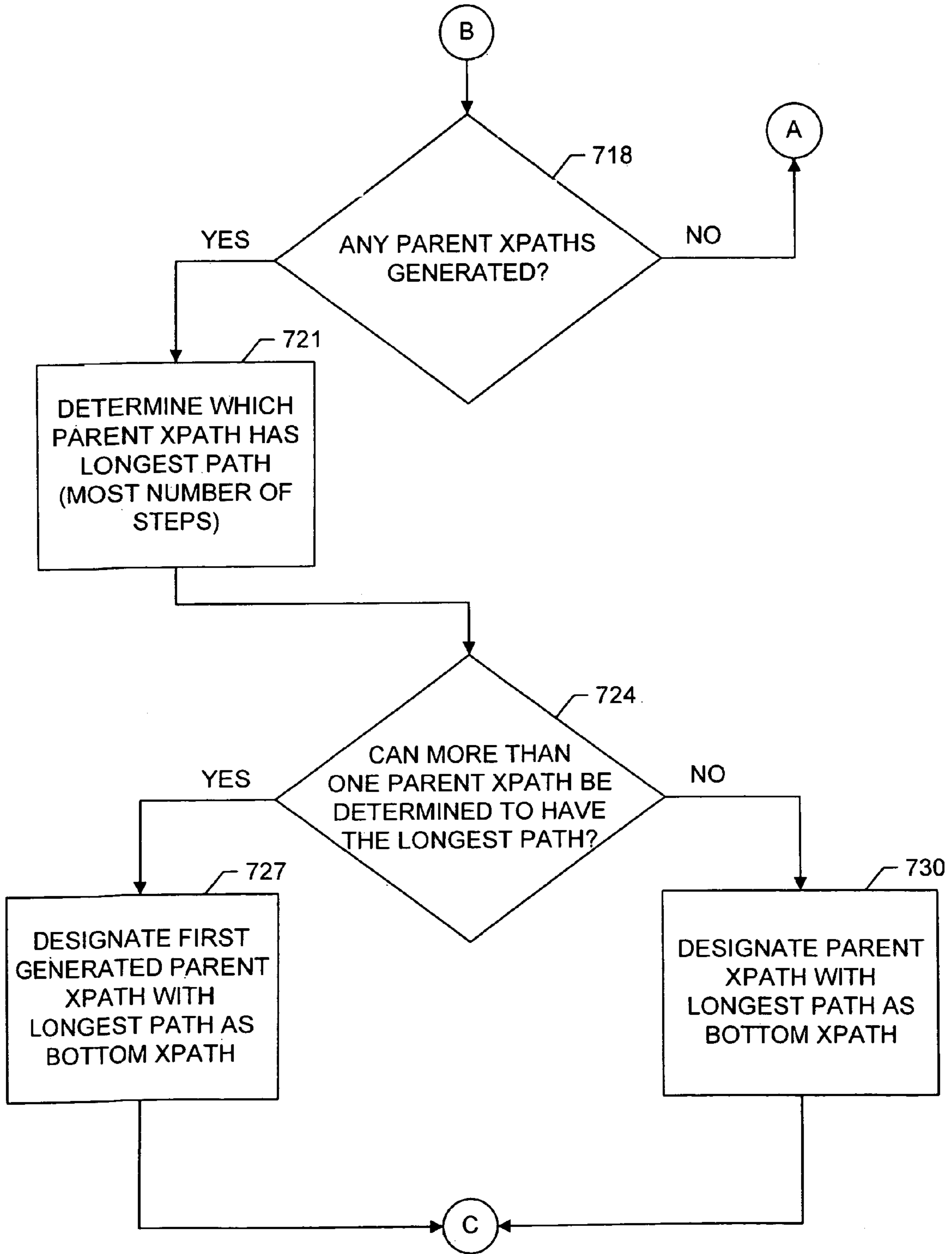


FIG. 7B

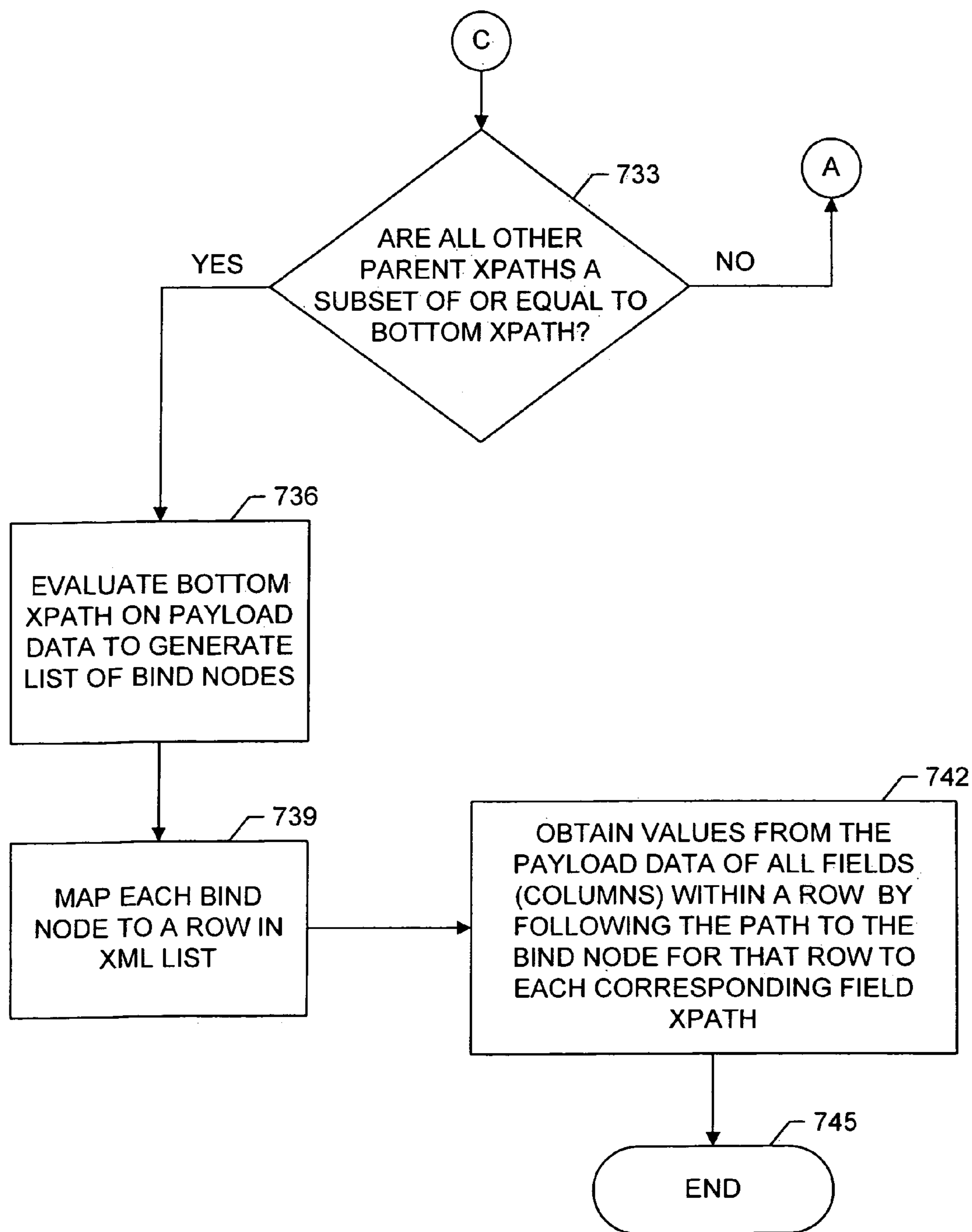


FIG. 7C

SYSTEM AND METHOD FOR SCHEMALESS DATA MAPPING

RELATED APPLICATION

This utility patent application is a continuation of and claims the benefit under 35 United States Code §120 of U.S. patent application Ser. No. 10/772,001 entitled "System and Method for Schemaless Data Mapping" filed on Feb. 4, 2004, now abandoned the disclosures of which are expressly incorporated by reference.

TECHNICAL FIELD

The present invention relates, generally, to data mapping systems and methods, and, more particularly, to data mapping systems and methods without the use of a schema.

BACKGROUND OF THE INVENTION

As extensible markup language (XML) becomes more prevalent for moving data between applications, particularly over the Internet, popular applications have implemented web-related capabilities (e.g., document publishing to the web) through the use of XML. One such application is MICROSOFT EXCEL offered by Microsoft Corporation of Redmond, Wash. XML lists were introduced to display XML payload data conforming to a predetermined schema. Typically, the relationship between the XML payload data and the makeup of an XML list is defined by an XML map, which is part of the spreadsheet workbook definition. The XML map may determine the location of an XML list in the workbook, the number of columns that will be mapped, and the type of element or attribute associated with each column. An XML Spreadsheet (XMLSS) file describes the spreadsheet workbook, including all XML lists that the workbook contains. Elements of the predetermined schema are mapped onto a grid to create a mapped XML list, with each row representing a node instance of the payload data. Generally, the schema defines the shape of the XML payload data.

In order for a spreadsheet application to provide effective interactivity over the Internet, the spreadsheet application must ensure that a given workbook is loaded and displayed over a network as it would be on a stand-alone system. A critical part of this fidelity is the mapping of payload data into XML lists. Such mapping requires the use of a predetermined schema.

Unfortunately, the reliance of a predetermined schema to map XML payload data to an XML list may be problematic. For example, if the schema is unavailable or corrupt the data may not be properly mapped. Additionally, applying a schema to payload data and XML lists may require intensive processing by a computer processing unit (CPU). Such a burden to the processor may be impractical or disadvantageous for computing systems such as servers or hand-held devices.

Accordingly, there is a need in the art for a system and method for mapping payload data to a spreadsheet list without the use of a schema.

There is also a need in the art for a system and method for mapping payload data to a spreadsheet list without the use of a schema, wherein the result is substantially similar to data mapping with a schema.

SUMMARY OF THE INVENTION

Broadly described, the present invention comprises a system and method for mapping payload data to a spreadsheet list (e.g., XML list) of spreadsheet data. More particularly, the present invention comprises a system for mapping payload data to a spreadsheet list without the use of a schema. After receiving a spreadsheet list, the present invention generates the parent path of each field path defined in the spreadsheet list. The longest parent path (e.g., bottom path) may be used to generate a set of bind nodes from the payload data. The present invention may map each bind node to a row in the spreadsheet list. By traversing from the bind node using the bottom path and the field paths, the present invention may obtain the values of all of the other fields in the rows of the spreadsheet list.

Advantageously, the present invention maps payload data to a spreadsheet list without the use of a schema. The present invention provides a result substantially similar to one generated by using a schema. Accordingly, the present invention eliminates a dependency on the schema to map payload data to a spreadsheet list and, therefore, reduces the potential of data mapping failure. Additionally, the elimination of such a dependency (e.g., processor-intensive data mapping) frees the valuable resources of the computer processing unit for more important tasks.

Other features and advantages of the present invention will become apparent upon reading and understanding the present specification when taken in conjunction with the appended drawings.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 displays a block diagram representation of a spreadsheet data mapping system in accordance with an exemplary embodiment of the present invention.

FIG. 2 displays a block diagram representation of a computing environment and computer systems thereof which the present invention may utilize in accordance with an exemplary embodiment thereof.

FIG. 3 displays a pseudo-code representation of spreadsheet data including a spreadsheet list in accordance with an exemplary embodiment of the present invention.

FIG. 4 displays a pseudo-code representation of payload data in accordance with an exemplary embodiment of the present invention.

FIG. 5 displays a block diagram of payload data in accordance with an exemplary embodiment of the present invention.

FIG. 6 displays a block diagram of a mapped spreadsheet list in accordance with an exemplary embodiment of the present invention.

FIGS. 7A-7C display a flowchart representation of a method of mapping payload data to a spreadsheet list in accordance with an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, in which like numerals represent like components or steps throughout the several views, FIG. 1 displays a block diagram representation of a spreadsheet data mapping system **100** in accordance with an exemplary embodiment of the present invention. The spreadsheet data mapping system **100** may comprise a communication device **103** including, but not limited to, a spreadsheet storage unit **109**, a payload data storage unit **105**, and a

mapping unit **106**. The communication device **103** may be supported by hardware and software components similar to those found in well-known computing systems, environments, and/or configurations, described more fully below with reference to FIG. **2**.

The spreadsheet storage unit **109** communicatively connects to the mapping unit **106**. The spreadsheet storage unit **109** stores spreadsheet data including spreadsheet lists such as, but not limited to, extensible markup language (XML) lists **112**, described more fully below with reference to FIG. **3**. The spreadsheet storage unit **109** comprises a memory device capable of storing and retrieving data including, but not limited to, random access memory (RAM), flash memory, magnetic memory devices, optical memory devices, hard disk drives, removable volatile or non-volatile memory devices, optical storage mediums, magnetic storage mediums, or RAM memory cards. Alternatively, the spreadsheet storage unit **109** may comprise a remote storage facility accessible through a wired and/or wireless network system. Additionally, the spreadsheet storage unit **109** may comprise a memory system including a multi-stage system of primary and secondary memory devices, as described above. The primary memory device and secondary memory device may operate as a cache for each other or the second memory device may serve as a backup to the primary memory device. In yet another arrangement, the spreadsheet storage unit **109** may comprise a memory device configured as a simple database file or as a searchable, relational database using a query language, such as SQL.

The payload data storage unit **115** communicatively connects to the mapping unit **106**. The payload data storage unit **115** stores payload data, wherein the payload data may be mapped to a corresponding XML list **112** of the spreadsheet data. Payload data is described more fully below with reference to FIG. **4**. The payload data storage unit **115** comprises a memory device similar to the memory devices described above with reference to the spreadsheet storage unit **109**.

The mapping unit **106** communicatively connects to the spreadsheet storage unit **109** and the payload data storage unit **115**. The mapping unit **106** is configured with hardware and software (see FIG. **2**) appropriate to perform tasks and provide capabilities and functionality as described herein. The mapping unit **106** may be adapted to map payload data stored on the payload data storage unit **115** to XML lists **112** stored on the spreadsheet storage unit **109**.

In operation, the mapping unit **106** receives spreadsheet data from the spreadsheet storage unit **109** and receives payload data from the payload data storage unit **115**. The spreadsheet data may include XML lists **112** that may generally be defined by a group of fields (also referred to herein as “columns”). Typically, a field may be calculated or mapped. Calculated fields may be defined by a formula or constant value, while mapped fields may be defined by a “path” or “pointer” to payload data. The mapping unit **106** may utilize the field paths to obtain a list of nodes (e.g., sometimes referred to as “bind nodes”) from the payload data, whereby each node may then be mapped by the mapping unit **106** to a row in an XML list **112**. The mapping unit **106** may obtain values from the payload data for all the fields within the XML list **112** by following a path from the bind nodes to the desired fields.

In an alternative embodiment of the present invention, the communication device **103** further comprises a user interface **118** that may be adapted to display data to a user and receive user input. The user interface **118** communicatively connects to the mapping unit **106**. The mapping unit **106** may provide mapped XML lists **112** to the user interface **118**, which may display the mapped XML lists **112** to the user via a display

(not shown). One skilled in the art will recognize that the user interface **118** may be designed in a variety of embodiments and formats and may range from a simple to a more complex configuration. In an exemplary embodiment of the present invention, the user interface **118** may comprise a keypad, display, touch screen or other convenient device, and may also comprise program modules or machine instructions that perform the predetermined tasks, which instructions may be executed on a processing unit **212**.

Additionally, the communication device **103** may comprise a network interface **121** for facilitating communication from the communication device **103** to a network **124**. The network interface **121** communicatively connects to the mapping unit **106** and a network **124**. The mapping unit **106** may provide mapped XML lists **112** to the network interface **121**, which may provide the mapped XML lists **112** to another communication device within the network **124**. The network interface **121** typically may be a hardware device, such as a network interface card or an expansion card of the communication device **103**, which facilitates connectivity between the communication device **103** and the network **124**. Although not shown in FIG. **1**, the network interface **121** may comprise a radio transmitter and receiver which enable wireless communication between the communication device **103** and an access point (not shown) of the network **124**.

One skilled in the art will recognize that a network **124** typically comprises the infrastructure and facilities appropriate to connect a group of two or more communication devices **103** (including, without limitation, a plurality of servers or client devices). Such a network **124**, communication device **103**, and servers may be configured in multiple topologies including, but not limited to, star, bus, or ring configurations. Also, a network **124**, communication device **103**, and servers may be broadly categorized as belonging to a particular architecture including, but not limited to, peer-to-peer or client/server architectures. The network **124** may additionally be classified by the geographical location of the communication devices **103** or servers and the types thereof. For example, a network **124** connecting a plurality of computer systems or servers located proximate to each other, such as within a building, is referred to as a local-area network (LAN); if the computer systems are located farther apart, the network **124** is generally referred to as a wide-area network (WAN), such as the Internet; if the computer systems are located within a limited geographical area, such as a university campus or military establishment, the network **124** is referred to as a campus-area network (CAN); if the computer systems are connected together within a city or town, the network **124** is referred to as a metropolitan-area network (MAN); and if the computer systems are connected together within a user’s home, the network **124** is referred to as a home-area network (HAN).

One skilled in the art will recognize that connecting communicatively may include or require any appropriate type of connection for the bi-directional communication of signals and/or media including, but not limited to, analog, digital, wired and wireless communication channels. Such communication channels may utilize, but not be limited to, copper wire, optical fiber, radio frequency, infrared, satellite, or other facilities and media.

While several embodiments of the present invention refer to XML spreadsheet data, XML lists, and XML payload data, one skilled in the art will recognize that other types of data configurations may be used within the scope of the invention and, therefore, the present invention is not limited to data configured in XML.

5

FIG. 2 displays a block diagram representation of a computing environment 200 and computer systems 210, 280 thereof which the present invention may utilize in accordance with an exemplary embodiment thereof. The computing environment 200 and computer systems 210, 280 thereof represent only one example of a suitable computing environment and computer systems for the practice of the present invention and are not intended to suggest any limitation as to the scope of use or functionality of the invention. Nor should the computer systems 210, 280 be interpreted as having any dependency or requirement relating to any one or combination of components illustrated in the exemplary computing environment 200.

Hence, it should be understood that the present invention is operational with numerous other general purpose or special purpose computing system environments or configurations. Examples of well-known communication devices 103, computing systems, environments, and/or configurations that may be appropriate or suitable for use with the present invention include, but are not limited to, personal computers, server computers, hand-held or laptop devices, multiprocessor systems, microprocessor-based systems, set top boxes, programmable consumer electronics, network personal computers, minicomputers, mainframe computers, distributed computing environments that include any of the above systems or devices, and the like.

The present invention may also be described in the general context of comprising computer-executable instructions, such as program modules, being executed by a computer system. Generally, program modules include routines, programs, programming, objects, components, data, and/or data structures that perform particular tasks or implement particular abstract data types. The present invention may be practiced in distributed computing environments where tasks are performed by remote processing devices that are linked through a communications network. In a distributed computing environment, program modules may be located in both local and remote computer storage media, including, without limitation, in memory storage devices.

With reference to FIG. 2, an exemplary computing environment 200 of the present invention includes a general purpose computing device in the form of a computer system 210. Components of computer system 210 may include, but are not limited to, a processing unit 220, a system memory 230, and a system bus 221 that couples various system components including the system memory 230 to the processing unit 220 for bi-directional data and/or instruction communication. The system bus 221 may be any of several types of bus structures including a memory bus or memory controller, a peripheral bus, and a local bus using any of a variety of bus architectures. By way of example, and not limitation, such architectures include the Industry Standard Architecture (ISA) bus, Micro Channel Architecture (MCA) bus, Enhanced ISA (EISA) bus, Video Electronics Standards Association (VESA) local bus, and Peripheral Component Interconnect (PCI) bus (i.e., also known as the "Mezzanine bus").

Computer system 210 typically includes a variety of computer-readable media. Computer-readable media may comprise any available media that may be accessed by, read from, or written to by computer system 210 and may include both volatile and nonvolatile, removable and non-removable media. By way of example, and not limitation, computer-readable media may comprise computer storage media and communication media. Computer storage media includes both volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data,

6

data structures, program modules, programs, programming, or routines. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magneto-optical storage devices, magnetic disk storage or other magnetic storage devices, or any other medium which may be used to store the desired information and which may be accessed by computer system 210. Communication media typically embodies computer-readable instructions, data, data structures, program modules, programs, programming, or routines in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of any of the above are also included within the scope of computer-readable media.

The system memory 230 includes computer storage media in the form of volatile and/or nonvolatile memory such as read only memory (ROM) 231 and random access memory (RAM) 232. A basic input/output system 233 (BIOS), containing the basic routines that direct the transfer of information between elements within computer 210, such as during start-up, is typically stored in ROM 231. RAM 232 typically stores data and/or program instructions that are immediately accessible to and/or presently being operated on by processing unit 220. By way of example, and not limitation, FIG. 2 illustrates operating system 234, application programs 235, other program modules 236, and program data 237 which may be resident in RAM 232, in whole or in part, from time-to-time.

The computer 210 may also include other removable/non-removable, volatile/nonvolatile computer storage media. By way of example only, FIG. 2 illustrates a hard disk drive 241 that reads from or writes to non-removable, nonvolatile magnetic media, a magnetic disk drive 251 that reads from or writes to a removable, nonvolatile magnetic disk 252, and an optical disk drive 255 that reads from or writes to a removable, nonvolatile optical disk 256 such as a CD ROM or other optical media. Other removable/non-removable, volatile/nonvolatile computer storage media that may be included in the exemplary computing environment 200 include, but are not limited to, magnetic tape cassettes, flash memory cards, digital versatile disks, digital video tape, solid state RAM, solid state ROM, and the like. The hard disk drive 241 is typically connected to the system bus 221 through a non-removable memory interface such as interface 240, and magnetic disk drive 251 and optical disk drive 255 are typically connected to the system bus 221 by a removable memory interface, such as interface 250.

The drives 241, 251, 255 and their associated computer storage media described above and illustrated in FIG. 2, provide storage of computer-readable instructions, data, data structures, program modules, programs, programming, or routines for computer system 210. In FIG. 2, for example, hard disk drive 241 is illustrated as storing operating system 244, application programs 245, other program modules 246, and program data 247. Note that these components may either be the same as or different from operating system 234, application programs 235, other program modules 236, and program data 237. Operating system 244, application programs 245, other program modules 246, and program data 247 are

given different numbers to illustrate that, at a minimum, they are different copies of operating system **234**, application programs **235**, other program modules **236**, and program data **237**. A user may enter commands and information into computer system **210** through connected input devices such as a keyboard **262** and pointing device **261**, commonly referred to as a mouse, trackball or touch pad. Other connected input devices (not shown) may include a microphone, joystick, game pad, satellite dish, scanner, or the like. These and other input devices are often connected to the processing unit **220** through a user input interface **260** that is coupled to the system bus **221**, but may be connected by other interface and bus structures, such as a parallel port, game port or a universal serial bus (USB). A monitor **291** or other type of display device is also connected to the system bus **221** via an interface, such as a video interface **290**. In addition to the monitor **291**, computer system **210** may also include other peripheral output devices such as speakers **297** and printer **296**, which may be connected through an output peripheral interface **295**.

The computer system **210** may operate in a networked environment using bi-directional communication connection links to one or more remote computer systems, such as a remote computer system **280**. The remote computer system **280** may be a personal computer, a laptop computer, a server computer, a router, a network PC, a peer device or other common network node, and typically includes many or all of the elements described above relative to the computer system **210**, although only a memory storage device **281** of remote computer system **280** has been illustrated in FIG. 2. The bi-directional communication connection links depicted in FIG. 2 include a local area network (LAN) **271** and a wide area network (WAN) **273**, but may also include other networks. Such networks are commonplace in offices, enterprise-wide computer networks, intranets and the Internet.

When communicatively connected to a LAN **271**, the computer system **210** connects to the LAN **271** through a network interface or adapter **270**. When communicatively connected to a WAN **273**, the computer system **210** typically includes a modem **272** or other means for establishing a communication link over the WAN **273**, such as the Internet. The modem **272**, which may be internal or external, may be connected to the system bus **221** via the user input interface **260**, or other appropriate mechanism. In a networked environment, program modules depicted relative to the computer system **210**, or portions thereof, may be stored in the remote memory storage device **281**. By way of example, and not limitation, FIG. 2 illustrates remote application programs **285** as residing in memory storage device **281**. It will be appreciated that the network connections shown are exemplary and other means of establishing a bi-directional communication link between the computers may be used.

FIG. 3 displays a pseudo-code representation **300** of spreadsheet data including a spreadsheet list **112** in accordance with an exemplary embodiment of the present invention. As discussed above, the spreadsheet storage unit **109** includes spreadsheet lists **112** that may be mapped with payload data by the mapping unit **106**. In an exemplary embodiment of the present invention, the spreadsheet lists **112** are configured in XML code and, therefore, are hereinafter referred to as XML lists **112**.

XML provides customizable tags that permit the definition, validation, transmission, and interpretation of data between a plurality of systems. One skilled in the art will recognize that XML is derived from standard generalized markup language (SGML) and provides a widely-accepted code format for the configuration of data. Generally, XML tags are commands used within a document or code that indicate how the portion

of a document or code should be formatted or interpreted. XML tags are typically paired and include a beginning tag and an ending tag. The beginning tag is often represented by a tag name between a less than (“<”) and greater than (“>”) symbol. The ending tag is usually identical to the beginning tag except that after the less than symbol (“<”) there is a forward slash (“/”). For example, and not limitation, the range element **306** begins with a “<range>” tag and ends with a “</range>” tag. All of the text or code between the beginning “<range>” tag and the ending “</range>” tag may be interpreted as part of the range element **306**.

More specifically, FIG. 3 displays a portion of an XML spreadsheet (XMLSS), which describes a spreadsheet workbook, including the XML list **112** contained therein. The entry element **303** (e.g., <entry x2:id=“list1”> . . . </entry>) represents a single XML list **112** within the spreadsheet data. The XML list **112** may be defined by a group of columns referred to as fields, which may be represented in the XML list **112** by the field element **312A-312D** (e.g., <field> . . . </field>). The field elements **312A-312D**, therefore, represent the columns resulting from the mapping of payload data to the XML list **112** by the mapping unit **106**.

A field may be calculated or mapped. A calculated field may be defined by either a formula or a constant value. A mapped field may be defined by a path to the payload data. As shown in FIG. 3, a field path may be represented in the XML list **112** by the xpath element **309B-309E** (e.g., <xpath> . . . </xpath>). The entry element **303** may also have a path (e.g., sometimes referred to as the “root path”) and may also be represented by an xpath element **309A**. The field path is a relative xpath **309B-309E** to the entry path and, therefore, the full path to a field requires concatenating the entry path with the field path. For example and not limitation, the field path represented by xpath element **309C** of field element **312B** is “DEPARTMENTID”. The full path of the field represented by field element **312B**, however, requires combining the entry xpath represented by xpath element **309A** with the field path represented by xpath element **309C** and, therefore, results in a full path of “/DEPARTMENT/DEPARTMENTID”.

A field may also be associated with a particular data or definition type such as, but not limited to, a string, a variable, or an integer. A field’s data or definition type may be represented, as shown in FIG. 3, by an xsdtype element **315A-315D**. Using the example above, the data or definition type represented by xsdtype **315B** of the field represented by field element **312B** is “STRING”.

One skilled in the art will recognize that an XML list **112** may be configured in numerous arrangements and may comprise a variety of fields and paths. Accordingly, the spreadsheet data displayed in FIG. 3 is for illustrative purposes only and does not limit the scope of the present invention.

FIG. 4 displays a pseudo-code representation **400** of payload data in accordance with an exemplary embodiment of the present invention. As discussed above, the payload data storage unit **115** includes payload data that may be mapped to an XML list **112** of the spreadsheet data. In an exemplary embodiment of the present invention, the payload data is configured in XML code. Payload data, generally, corresponds to the fields defined or described in the XML list **112**. Accordingly, the paths defined in an XML list **112** may correlate to XML tags within the payload data.

For example and not limitation, the payload data displayed in FIG. 4 relates to the XML list defined in FIG. 3. More specifically, the payload elements **403**, **406**, **409**, **412**, **415** shown in FIG. 4 correspond to the full field paths shown in FIG. 3. TABLE 1 displays the correlation between the full field paths of FIG. 3 with the payload elements of FIG. 4.

TABLE 1

```

/DEPARTMENT/@NAME
<DEPARTMENT NAME="ENGINEERING">
...
</DEPARTMENT>
<DEPARTMENT NAME="HUMAN RESOURCES">
...
</DEPARTMENT>
/DEPARTMENT/DEPARTMENTID
<DEPARTMENT. . .>
  <DEPARTMENTID>1001</DEPARTMENTID>
...
</DEPARTMENT>
<DEPARTMENT. . .>
  <DEPARTMENTID>1002</DEPARTMENTID>
...
</DEPARTMENT>
/DEPARTMENT/MANAGERS/PERSON/@NAME
<DEPARTMENT. . .>
...
  <MANAGERS>
    <PERSON NAME="JOHN">...</PERSON>
    <PERSON NAME="PETER">...</PERSON>
  </MANAGERS>
</DEPARTMENT>
<DEPARTMENT. . .>
...
  <MANAGERS>
    <PERSON NAME="COREY"></PERSON>
    <PERSON NAME="PAT">...</PERSON>
  </MANAGERS>
</DEPARTMENT>
/DEPARTMENT/MANAGERS/PERSON/PERSONID
<DEPARTMENT. . .>
...
  <MANAGERS>
    <PERSON. . .><PERSONID>20001</PERSONID></PERSON>
    <PERSON. . .><PERSONID>20002</PERSONID></PERSON>
  </MANAGERS>
</DEPARTMENT>
<DEPARTMENT. . .>
...
  <MANAGERS>
    <PERSON. . .><PERSONID>20002</PERSONID></PERSON>
    <PERSON. . .><PERSONID>20003</PERSONID></PERSON>
  </MANAGERS>
</DEPARTMENT>

```

As shown in Table 1, the department name elements **403A**, **403B** correspond to the full field path of “/DEPARTMENT/@NAME”; the departmentid elements **406A**, **406B** correspond to the full field path of “/DEPARTMENT/DEPARTMENTID”; the person name elements **412A-412D** correspond to the full field path of “/DEPARTMENT/PERSON/@NAME”; and the personid elements **415A-415D** correspond to the full field path of “/DEPARTMENT/PERSON/PERSONID”. In an exemplary embodiment of the present invention, the “/@” symbols in a field path indicate that the field is an attribute, while the “/” symbol in a field path indicates that the field is an element. Thus, “NAME” is an attribute of “DEPARTMENT” as indicated by the path “/DEPARTMENT/@NAME”, while “DEPARTMENTID” is an element of “DEPARTMENT” as indicated by the path “/DEPARTMENT/DEPARTMENTID”.

One skilled in the art will recognize that the configuration of the payload data may depend on or conform to the configuration of the XML lists **112**. Accordingly, the payload data represented in FIG. 4 is for illustrative purposes only and does not limit the scope of the present invention.

FIG. 5 displays a block diagram of payload data in accordance with an exemplary embodiment of the present invention. The payload data displayed in FIG. 5 resembles the payload data discussed above with reference to FIG. 4, except without XML element tags. More specifically, FIG. 5 illustrates the hierarchical characteristics of the field paths of the spreadsheet data (see FIG. 3) and the payload data associated therewith.

In an exemplary embodiment of the present invention, the mapping unit **106** may determine the “parent” path of each field path in an XML list **112** (described more fully below with reference to FIG. 7). A parent path of a particular field path may be determined by following the field path one step back in the path. In other words, the parent path is one step back in the hierarchy than the field path. For example and not limitation, the field path “/DEPARTMENT/MANAGERS/PERSON/PERSONID/” may have a parent path of “/DEPARTMENT/MANAGERS/PERSON”. Additionally, a parent path may be calculated for attribute and element fields. Thus, an attribute field path of “/a/b/@c” and an element field path of “/a/b/c” may have the same parent path of “/a/b”.

FIG. 5 also illustrates how a field path may be followed to the corresponding payload data. For example and not limitation, the mapping unit **106** may follow the field path of “/DEPARTMENT/DEPARTMENTID” and discover the corresponding values of “1001” and “1002”. Conversely, a field path may be determined from payload data. For example and not limitation, the payload data “John” may have a corresponding field path of “/DEPARTMENT/MANAGERS/PERSON/@NAME”.

FIG. 6 displays a block diagram of a mapped spreadsheet list **112** in accordance with an exemplary embodiment of the present invention. As described above, the mapping unit **106** may map the payload data to an XML list **112** of the spreadsheet data. Although such mapping does not rely on a schema, the resulting mapped spreadsheet list **112** substantially resembles that of a “schema-mapped” spreadsheet list.

In an exemplary embodiment of the present invention, the mapping unit **106** may designate a “bottom” path for the XML list **112** (described more fully below with reference to FIG. 7). Typically, the bottom path is the longest path of the previously generated parent paths (described above with reference to FIG. 5). If more than one parent path qualifies as the longest path, the parent path that was generated first may be designated as the bottom path.

The mapping unit **106** may use the bottom path to designate the bind nodes of the XML list **112**. Typically, the bind nodes may be assigned to a row in the mapped XML list **112**. The bind nodes may act as the index for each row of the XML list **112**. More specifically, the bind nodes indicate the number of rows that exist in the mapped XML list **112**.

For example and not limitation, the parent paths of the fields illustrated in FIG. 3 are “/DEPARTMENT” (e.g., the parent path of “/DEPARTMENT/@NAME”), “/DEPARTMENT” (e.g., the parent path of “/DEPARTMENT/DEPARTMENTID”), “/DEPARTMENT/MANAGERS/PERSON” (e.g., the parent path of “/DEPARTMENT/MANAGERS/PERSON/@NAME”), and “/DEPARTMENT/MANAGERS/PERSON” (e.g., the parent path of “/DEPARTMENT/MANAGERS/PERSON/PERSONID”). The mapping unit **106** may designate “/DEPARTMENT/MANAGERS/PERSON” (e.g., the parent path of “/DEPARTMENT/MANAGERS/PERSON/@NAME”) as the bottom path, because it is the longest parent path generated. The mapping unit **106** then follows the bottom path to determine the bind nodes. As displayed in FIG. 6, the bind nodes associated with the designated bottom path include the

11

values in column 612 (e.g., “John”, “Peter”, “Corey”, and “Pat”). The other row 618, 621, 624, 627, 630 and column 603, 606, 612, 615 values of the mapped XML list 112 may be determined by following the bottom path to each corresponding field path.

FIGS. 7A-7C display a flowchart representation of a method 700 of mapping payload data to a spreadsheet list 112 in accordance with an exemplary embodiment of the present invention. The mapping unit 106 maps payload data received from the payload storage unit 115 to an XML list received from the spreadsheet storage unit 109 without the use of a schema.

After starting at step 701, the mapping unit 106 proceeds to step 703 where the mapping unit 703 receives spreadsheet data from the spreadsheet storage unit 109. The spreadsheet data may include XML lists 112. Next, at step 706 the mapping unit 106 determines whether any XML lists 112 need to be evaluated. If, at step 706, the mapping unit 106 determines that no XML lists 112 need to be evaluated, then the mapping unit 106 halts operation in accordance with method 700 at step 715. If, however, at step 706 the mapping unit 106 determines that there exist XML lists 112 to be evaluated, then the mapping unit 106 proceeds to step 709 where the mapping unit 106 determines whether any field paths within an XML list 112 needs to be evaluated. If at step 709, the mapping unit 106 determines that no field paths need to be evaluated, then the mapping unit 106 proceeds to step 718, described below. If, however, at step 709 the mapping unit 106 determines that field paths exist that need to be evaluated, then the mapping unit 106 proceeds to step 712 where the mapping unit 106 generates a parent path for a field path. The mapping unit 106 then proceeds to step 709, described above.

At step 718, the mapping unit 106 determines whether any parent paths were generated from the field paths of the XML list 112. If, at step 718 the mapping unit 106 determines that no parent paths were generated, then the mapping unit 106 proceeds to step 706 described above. Otherwise, if at step 718 the mapping unit 106 determines that parent paths were generated, then the mapping unit proceeds to step 721 where the mapping unit 106 determines which parent path has the longest path. Next, at step 724, the mapping unit 106 determines if more than one parent path may qualify as the longest path. If at step 724 the mapping unit 106 determines that more than one parent path may qualify as the longest path, then the mapping unit 106 proceeds to step 727 where the first generated parent path with the longest path is designated as the bottom path. The mapping unit 106 then proceeds to step 733 described below. If, however, at 724 the mapping unit 106 determines that no more than one parent path qualifies as the longest path, then the mapping unit 106 proceeds to step 730 where the parent path with the longest path is designated as the bottom path.

At step 733, the mapping unit 106 determines whether all of the other parent paths are subsets or equal to the designated bottom path. If, at step 733, the mapping unit 106 determines that not all of the other parent paths are subsets or equal to the designated bottom path, then the mapping unit 106 proceed to step 706, described above. If, however, at step 733 the mapping unit 106 determines that all other parent paths are subsets or equal to the designated bottom path, then the mapping unit 106 proceeds to step 736 where the mapping unit 106 evaluates the bottom path on the payload data received from the payload data storage unit 115 to generate a list of bind nodes. Next, at step 739, the mapping unit 106 maps each bind node to a row in the XML list 112. Then, at step 742, the mapping unit 106 obtains values from the payload data for all other fields within each row of the XML list 112 by following the

12

path to the bind node for that row to each corresponding field path. The mapping unit 106 then terminates operation in accordance with method 700 at step 745.

Whereas the present invention has been described in detail it is understood that variations and modifications may be effected within the spirit and scope of the invention, as described herein before and as defined in the appended claims. The corresponding structures, materials, acts, and equivalents of all mean-plus-function elements, if any, in the claims below are intended to include any structure, material, or acts for performing the functions in combination with other claimed elements as specifically claimed.

What is claimed is:

1. A computer-implemented method for mapping payload data in a markup language format to spreadsheet lists to generate a spreadsheet populated with said payload data, the method comprising the steps of:

receiving spreadsheet data including at least one spreadsheet list, wherein said at least one spreadsheet list describes a spreadsheet structure including one or more fields included in a row of a spreadsheet and includes at least one path associated with one of the fields;

receiving payload data, wherein said payload data is associated with said spreadsheet data;

mapping said payload data to said at least one spreadsheet list independent of any schema associated with the payload data by:

generating a set of parent paths for said at least one path; determining a longest parent path of said set of parent paths;

designating a parent path of said set of parent paths as a bottom path; and

generating a set of nodes from said payload data, wherein said set of nodes is generated by evaluating said bottom path on said payload data;

mapping a node of said set of nodes to a row of said at least one spreadsheet list; and

retrieving a value of said field within said row by tracing said bottom path to said at least one path associated with said field within said spreadsheet data; and

causing the spreadsheet to be presented to a user via an output device wherein the spreadsheet manifests the spreadsheet structure populated with the payload data.

2. The computer-implemented method of claim 1, wherein generating a set of parent paths for said at least one path comprises the steps of:

enumerating said at least one path of said spreadsheet data; following enumerated said at least one path back to a previous field; and

inserting a path associated with said previous field into said set of parent paths.

3. The computer-implemented method of claim 1, wherein designating a parent path of said set of parent paths as a bottom path comprises the steps of:

determining a longest parent path of said set of parent paths, wherein a first parent path is designated as said longest parent path if more than one parent path qualifies as said longest parent path; and

designating said longest parent path as a bottom path.

4. A computer-readable storage medium storing computer-executable instructions for mapping payload data to spreadsheet lists, the computer-executable instructions performing the steps of:

receiving spreadsheet data including at least one spreadsheet list, wherein said at least one spreadsheet list includes at least one path associated with a field;

13

receiving payload data, wherein said payload data is associated with said spreadsheet data and is presented without a schema file identifying a structure of the payload data;

mapping said payload data to said at least one spreadsheet list by generating a set of parent paths for said at least one path, determining a longest parent path of said set of parent paths, designating a parent path of said set of parent paths as a bottom path, and generating a set of nodes from payload data, wherein said set of nodes is generated by evaluating said bottom path on said payload data;

enumerating said at least one path of said spreadsheet data; following enumerated said at least one path back to a previous field; and

inserting a path associated with said previous field into said set of parent paths; and

causing the spreadsheet to be presented to a user via an output device wherein the spreadsheet manifests the spreadsheet structure populated with the payload data.

5. The computer-readable storage medium of claim 4, wherein mapping said payload data to said at least one spreadsheet list by using said at least one path further comprises the steps of:

mapping a node of said set of nodes to a row of said at least one spreadsheet list; and

retrieving a value of said field within said row by tracing said bottom path to said at least one path associated with said field within said spreadsheet data.

6. The computer-readable storage medium of claim 4, wherein designating a parent path of said set of parent paths as a bottom path comprises the steps of:

determining a longest parent path of said set of parent paths, wherein a first parent path is designated as said longest parent path if more than one parent path qualifies as said longest parent path; and

designating said longest parent path as a bottom path.

7. A computer-implemented method for mapping payload data in a markup language format to spreadsheet lists to generate a spreadsheet populated with said payload data, the method comprising the steps of:

receiving spreadsheet data including at least one spreadsheet list, wherein said at least one spreadsheet list describes a spreadsheet structure including one or more fields included in a row of a spreadsheet and includes at least one path associated with one of the a fields;

14

receiving payload data, wherein said payload data is associated with said spreadsheet data;

mapping said payload data to said at least one spreadsheet list independent of any schema associated with the payload data by:

generating a set of parent paths for said at least one path; determining a longest parent path of said set of parent paths;

designating a parent path of said set of parent paths as a bottom path; and

generating a set of bind nodes from said payload data, wherein said set of bind nodes is generated by evaluating said bottom path on said payload data; and

traversing from each of the bind nodes using the bottom path to obtain the values of other fields in each of the one or more rows of the spreadsheet; and

causing the spreadsheet to be presented to a user via an output device wherein the spreadsheet manifests the spreadsheet structure populated with the payload data.

8. The computer-implemented method of claim 7, wherein mapping said payload data to said at least one spreadsheet list by using said at least one path further comprises the steps of:

mapping a node of said set of nodes to a row of said at least one spreadsheet list; and

retrieving a value of said field within said row by tracing said bottom path to said at least one path associated with said field within said spreadsheet data.

9. The computer-implemented method of claim 7, wherein generating a set of parent paths for said at least one path comprises the steps of:

enumerating said at least one path of said spreadsheet data; following enumerated said at least one path back to a previous field; and

inserting a path associated with said previous field into said set of parent paths.

10. The computer-implemented method of claim 7, wherein designating a parent path of said set of parent paths as a bottom path comprises the steps of:

determining a longest parent path of said set of parent paths, wherein a first parent path is designated as said longest parent path if more than one parent path qualifies as said longest parent path; and

designating said longest parent path as a bottom path.

* * * * *